



DYNAMIC SYSTEMS®

**U.S. Army Contracting Command  
Rock Island**

*PROJECT NAME:*

**White Paper  
for  
Thin Client Configuration**

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*PREPARED BY*

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## Introduction

For the past 15 years, Dynamic Systems architected, implemented, managed and maintained Thin Client implementations from a few users to over 1,500 users for our Public Sector customers. We also run our company on Thin Client technology so we understand this technology from our foundation. Our implementations also include DoD environments with multi-level security, including CAC (Common Access Card) readers and other associated technology. Whether deploying for a workgroup or small company with less than 500 users or a large enterprise with more 500 users, a Thin Client solution requires knowledge and expertise across the entire IT spectrum – Devices, Servers, Storage, Networking, Operating Systems, Applications, User Management, Printing, and overall solution Management and Monitoring – to implement successfully. We developed and proved our expertise working with customers such as DISA who awarded Dynamic Systems the DISA Thin Client Desktop Unit (DTU) BPA in 2011 which encompassed Thin Client components including desktop units, monitors, and Keyboard Video Mouse (KVM) switches, software licenses, and professional services required to implement their Thin Client solution.

In February 2016, the United States Army awarded a contract to Dynamic Systems as part of its ITES-3H program. In support of this program, Dynamic Systems developed this white paper to present an overview of Thin Client environments, provide environment sizing guidelines, a sample list of materials, and an overview of implementation methodologies. We intend to update the document annually to reflect changes in Thin Client technology and enhancements in the server, storage, and networking technologies which support these environments.

## Thin Client Environments

Today, more Thin Client device choices exist than at any time, with a range of features such as embedded operating systems, firmware, PCoIP (PC-over-IP) chipsets, single or multiple monitors, CAC readers, and RJ-45, Wi-Fi and or fiber network cabling. Management of the Thin Client devices lies in management of the embedded operating system or the firmware, depending on device type. The management tools require keeping an inventory of firmware revisions installed on each device and scheduling updates across the enterprise as necessary. With the popularity of tablet computing, software-based Thin Client access is possible as well.

Servers act as the heart of the Thin Client implementation and must be sized to support the number of maximum concurrent Thin Client users. Sizing varies based on the CPU and memory workloads of each of the users' applications (i.e., office productivity applications versus computation or graphics intensive applications), the type of implementation (i.e., Microsoft Remote Desktop Services or Virtual Desktop Infrastructure (VDI)), and the ability to leverage thin provisioned storage. Typically, multiple dual-processor servers provide redundancy and high availability while also allowing for easy and cost-effective scaling as the environment grows or requires technology refresh.

There are many aspects to the storage infrastructure for a Thin Client implementation. Of primary importance is the location of the user data (i.e., home directory), which should be placed on shared storage and accessible to all servers hosting Thin Client users, to allow for roaming profiles. When deploying a VDI solution, it is important to leverage high performance storage solutions (i.e., RAID 1 and SSDs) to mitigate the performance impact of launching many user virtual machines at the start of work shifts (sometimes called “Boot Storms”). The backup solution should provide for the automated backup of virtual machines as well as user and application data.

If servers are the heart of the solution, then networking acts as the arteries connecting the Thin Client devices to the servers. Today’s Thin Client devices can leverage existing networking infrastructure rather than needing a separate, isolated network. Most users’ complaints of Thin Client performance, however, generally relate to networking issues. Therefore, it is beneficial to create a Thin Client VLAN to aide in managing the overall performance of the Thin Client infrastructure. Sufficient network bandwidth must also exist to permit live migration of virtual machines between servers whether that is within the server room or between data centers.

The bulk of Thin Client deployments require only Microsoft Windows-based desktops. However, we have noticed an increase in requests to Linux-based servers and desktops as well as various mobile devices. As such we offer solutions capable of supporting Windows-only as well mixed operating system environments. In any of the solutions, key requirements associated with the user operating environment include user authentication and mobile profiles. At a minimum, user authentication involves connecting to Active Directory or to an Enterprise LDAP repository. For our DOD customers, it also requires authentication and single sign-on support for CAC cards. Many solutions provide the ability to employ antivirus and anti-malware solutions to scan and secure the user’s virtual machines while the user is offline so as not to disrupt the user’s activities.

The sizing of the environment and the selection of the Thin Client device depends on the users’ applications. Traditionally office productivity (MS Office Suite, Web and e-mail) require less in the way of computing resources. Desktop video conferencing, streaming video, and GIS applications, however, require data compression and optimization features to work properly in a Thin Client environment. For this reason, many Thin Client devices now incorporate PCoIP technology.

Management and monitoring tools providing operations dashboards and a single pane of glass for the infrastructure allow fewer system administrators to manage the Thin Client desktops without the need to physically visit the user’s desks. Health monitoring and performance analytics help anticipate performance bottlenecks. Capacity management and optimization ensures that capacity consumption is correctly sized and not over provisioned to enable the most efficient use of virtualized resources. If necessary to meet uptime and resiliency requirements, these tools also provide for the creation of failover groups allowing for the automated transfer of operations to

virtualization servers located at geographically separated continuity of operations (COOP) facility.

Thin Client solutions are a blend of desktop or mobile hardware, networking, software, and backend infrastructure serving up the processing power and applications. Through the life of the contract these will all be moving parts with interoperability needs. The savings of compute power at the end user site is balanced with the added networking demands and security needs as well as the back end computing required to provide a trusted Thin Client operating environment with the applications needed for mission execution. Planning and management is needed throughout the life cycle of the Thin Client solution, therefore support is needed from a partner who isn't just selling goods.

## Sizing Guidelines

Sizing a Thin Client environment depends on the users' applications. Traditional office productivity (MS Office Suite and e-mail) users require less in the way of computing resources than graphics-intensive applications. Desktop video conferencing, streaming video, and GIS applications, however, require or at least benefit from data compression and optimization features to work properly in a Thin Client environment. For this reason, many Thin Client devices now incorporate PCoIP technology.

Architectural components remain the same regardless of the size of the environment. The differences lie in the amount of physical infrastructure required to support the users' and organization's requirements. Based on our past experience, we follow these general sizing guidelines for a VDI-based Thin Client architecture:

	Guidelines	Example
<b>Server Sizing</b>	7-9 users/core	2x Intel Xeon E5-2699 v4, 3.00 GHz, 22-core 44 cores == 300-400 users
	2-4GB/desktop user	300 users == 600GB – 1.2TB system memory
<b>Storage Sizing</b>	15 users/VMs per RAID 1+0 pair of disk drives	300 users == 20 spindle pairs == 40 HDDs

Typical deployments tend toward a maximum of 200 users/servers to allow support of a mix of Office Worker and Knowledge Worker users. Note that the servers must be sized so that no particular resource is overcommitted – this includes CPU, Memory, Disk and Network.

Given these guidelines, a 500 user environment could require (2) servers with dual Intel Xeon E5-2699 v4, 2.2 GHz, 22-core CPUs and sufficient memory to meet the user's application needs – typically 2-4GB per desktop VM. Storage for the VMs require approximately 40 physical spindles and additional storage would be required for the user's home directory and application data. To meet operational redundancy, a third server should be placed at the primary server location to ensure that there is no loss of performance in the event of a single server failure. To scale this environment to support

up to 1,000 users requires (2) additional servers with the aforementioned configuration and approximately 40 additional spindles for storage. Additional servers and storage would be necessary to meet any COOP requirements. Minimum networking bandwidth between the servers is 1GbE and a minimum of 100MbE to the Thin Client devices, but 1GbE is highly recommended to satisfy user performance expectations relative to their dedicated desktop experience. Dynamic Systems will also work to ensure that all software licenses are appropriate, and we strive to minimize your licensing investment as much as possible.

## Thin Client Baseline Configurations

For each of the environments (500 and 1,000 users), the baseline configurations consist of servers, storage, Thin Client devices, and virtualization software. While networking plays a vital role in the performance of the environment, the configurations below assume that the solution integrates into the existing network infrastructure. If requested, Dynamic Systems will develop and provide suitable configuration materials lists for network infrastructure components.

### **Servers:**

Dynamic Systems recommends using standard server building blocks using Oracle Server X6-2 for the virtualization servers. Each Oracle Server X6-2 is configured with

- (2) Intel Xeon E5-2699 v4 22-core 2.2 GHz processors
- 768 GB memory
- (2) 600GB 10K RPM HDDs
- DVD
- (4) on-board 10GbE-BaseT interfaces
- (1) Integrated Lights Out Management port
- Oracle Premier Support for Systems, which includes OS Licenses for Oracle Linux, Oracle Solaris and Oracle Virtual Machine
- (1) Teradici PCoIP Hardware Accelerator APEX 2800 LP with support (optional)

Based on our Sizing Guidelines, two servers are required to meet the performance requirements for 500 users and we recommend a third server to achieve availability requirements. To grow the environment to 1,000 users requires an additional two servers for a total of five servers.

### **Storage**

For the shared storage infrastructure, we recommend the high performance Oracle ZFS Storage ZS3-2 Appliance. In the base configuration, we include dual, redundant controllers each with

- 512GB memory
- 3.2TB read cache
- (4) on-board 10GbE-BaseT interfaces
- (1) Integrated Lights Out Management port

To meet the performance needs of a 500 user environment, our Sizing Guidelines suggest (4) Drive Enclosures with a total of

- (80) 1.2TB 10K RPM HDDs, and
- (8) Write Cache SSDs.

To grow to 1,000 users simply requires an additional pair of drive enclosures for a complete environment consisting of (6) Drive Enclosures with a total of

- (128) 1.2TB 10K RPM HDDs, and
- (8) Write Cache SSDs.

### **Thin Client Devices**

Today, many suppliers offer Thin Client devices, but Dell's Wyse remains the market leader. For a VMware-based deployment, we recommend the Dell Wyse 5030 PCoIP due to its display performance, multiple display support, and option for fibre-based networking. The baseline configuration Thin Client device is the Dell Wyse 5030 PCoIP Zero Client for VMware with

- Keyboard,
- Mouse,
- 17" Dell monitor, and
- 3 Years ProSupport.

### **Virtualization Software**

In this sample configuration, Dynamic Systems provides configuration information for VMware's Horizon 7 Enterprise. VMware Horizon 7 Enterprise includes

- VDI
- ThinApp Packager/ Client
- Workstation (1 admin license)
- vSphere Desktop
- vCenter Desktop
  - Includes 25 Operating System Instances of VMware vRealize Log Insight for vCenter for Desktop
- Hosted Apps (RDSH)
- Mirage
- VMware Fusion® Pro
- Virtual SAN Advanced for Desktop
- App Volumes Enterprise
- User Environment Manager
- vRealize Operations for Horizon
- Linux VDI

VMware offers two license options for Horizon 7 Enterprise – Per Named User and Perpetual per Concurrent Connection. Named user licenses are intended for virtual environments with staff that require dedicated access to a virtual machine throughout the day. Perpetual per concurrent connection (CCU) are suited for virtual environments

with a high number of users who share machines throughout the day, such as students and shift workers. A concurrent connection is defined as the total number of users accessing or using the software at any given time to maintain an Active Connection to their workspace or desktop through an endpoint device. The configurations below include the Per Named User licenses.

## Environment Size: Less Than 500 Users (500 Users)

**Servers:** (3) Oracle Server X6-2

Quantity	Part Number	Description
3	7113206	Oracle Server X6-2: model family
6	7113235	1 Intel Xeon E5-2699 v4 22-core 2.2 GHz processor
72	7113243	One 32 GB DDR4-2400 registered DIMM
6	7111102	One 600 GB 10000 rpm 2.5-inch SAS-3 HDD
3	7113252	Oracle Server X6-2: 1 RU base chassis with motherboard, internal 12 Gb SAS RAID HBA, 2 PSUs, slide rail kit, and cable management arm
6	333V-20-15-C14	Power cord: North America and Asia, 2.5 meters, 5-15P plug, C13 connector, 15 A
3	7110339	Eight 2.5 inch drive slots, 1 DVD-RW drive slot, and disk cage for 1U
3	7110358	DVD-RW drive
3	B61304	Oracle Standard System Installation Service, Site Audit: Servers - Group II
3	B58179	Oracle Premier Support for Systems - Renewal Partner
3	SA2800004	Teradici PCoIP Hardware Accelerator APEX 2800 LP
3	SMSA003	Teradici Product Support & Maintenance - 3 years

**Storage:** Oracle ZFS Storage ZS3-2 Appliance with (4) Drive Enclosures

Quantity	Part Number	Description
1	7106195	Oracle ZFS Storage ZS3-2 appliance
1	7103796	Oracle ZFS Storage ZS3-2: model family
2	7103829	Oracle ZFS Storage ZS3-2: controller
32	7100731	One 32 GB DDR3-1066 DIMM
4	333V-20-15-C14	Power cord: Sun Rack jumper, straight, 2 meters, C14 plug, C13 connector, 15 A
4	7104203	One 1.6 TB 2.5-inch SAS SSD read flash accelerator
4	7103898	Oracle Storage Drive Enclosure DE2-24P: model family
4	7103910	Oracle Storage Drive Enclosure DE2-24P: base chassis
80	7111109	One 1.2 TB 10000 rpm 2.5-inch SAS-3 HDD
8	7110945	One 2.5-inch SSD write flash accelerator
8	333V-20-15-C14	Power cord: Sun Rack jumper, straight, 2 meters, C14 plug, C13 connector, 15 A
1	B61971	Oracle Standard System Installation Service, Without Site Audit: Storage Disk - Group III
4	B61473	Oracle Standard System Installation Service, Basic: Storage Disk - Group I

1	B72641	Oracle Standard Software Installation & Configuration for Systems Service: Base
1	B72649	Oracle Standard Software Installation & Configuration for Systems Service: Oracle ZFS Storage Appliance: Onsite Delivery
1	B58179	Oracle Premier Support for Systems - Renewal Partner

**Thin Client Device:** (500) Dell Wyse 5030 PCoIP Zero Client

Quantity	Part Number	Description
500	5030TAA	Wyse 5030 zero client for VMware, CTOG
500	503PCTA	5030 PCoIP - 32MB FLASH / 512MB DDR3 RAM
500	PCOIP	Operating System – Wyse Zero Clients, English
500	USKBYD	Dell Multimedia Keyboard-KB216 Black (US English)
500	USBSIB	Dell MS116 USB Optical Mouse
500	PS30W	30W AC Power Supply Adapter
500	USPWC	System 3 ft Power Cord (English)
500	STANDH	Horizontal Stand
500	E1715S	Dell 17 Monitor - E1715S
500	DVIVGA	DVI-I port. DVI to VGA (DB-15) adapter
500	PRMI3	3 Year ProSupport with Rapid Mail In Service

**Virtualization Software:** (500) VMware Horizon Enterprise Edition v.7 - License

Quantity	Part Number	Description
5	HZ7-ENN-100-F-L1	VMware Horizon Enterprise Edition ( v. 7 ) – license Level 1 ( 50-599 )
5	HZ7-ENN-100-P-SSS-F	VMware Support and Subscription Production

**Environment Size: More Than 500 Users (1,000 Users)**

**Servers:** (5) Oracle Server X6-2

Quantity	Part Number	Description
3	7113206	Oracle Server X6-2: model family
6	7113235	1 Intel Xeon E5-2699 v4 22-core 2.2 GHz processor
72	7113243	One 32 GB DDR4-2400 registered DIMM
6	7111102	One 600 GB 10000 rpm 2.5-inch SAS-3 HDD
3	7113252	Oracle Server X6-2: 1 RU base chassis with motherboard, internal 12 Gb SAS RAID HBA, 2 PSUs, slide rail kit, and cable management arm
6	333V-20-15-C14	Power cord: North America and Asia, 2.5 meters, 5-15P plug, C13 connector, 15 A
3	7110339	Eight 2.5 inch drive slots, 1 DVD-RW drive slot, and disk cage for 1U
3	7110358	DVD-RW drive

3	B61304	Oracle Standard System Installation Service, Site Audit: Servers - Group II
3	B58179	Oracle Premier Support for Systems - Renewal Partner
3	SA2800004	Teradici PCoIP Hardware Accelerator APEX 2800 LP
3	SMSA003	Teradici Product Support & Maintenance - 3 years

**Storage:** Oracle ZFS Storage ZS3-2 Appliance with (6) Drive Enclosures

Quantity	Part Number	Description
1	7106195	Oracle ZFS Storage ZS3-2 appliance
1	7103796	Oracle ZFS Storage ZS3-2: model family
2	7103829	Oracle ZFS Storage ZS3-2: controller
32	7100731	One 32 GB DDR3-1066 DIMM
4	333V-20-15-C14	Power cord: Sun Rack jumper, straight, 2 meters, C14 plug, C13 connector, 15 A
4	7104203	One 1.6 TB 2.5-inch SAS SSD read flash accelerator
4	7103898	Oracle Storage Drive Enclosure DE2-24P: model family
4	7103910	Oracle Storage Drive Enclosure DE2-24P: base chassis
80	7111109	One 1.2 TB 10000 rpm 2.5-inch SAS-3 HDD
8	7110945	One 2.5-inch SSD write flash accelerator
8	333V-20-15-C14	Power cord: Sun Rack jumper, straight, 2 meters, C14 plug, C13 connector, 15 A
2	7103898	Oracle Storage Drive Enclosure DE2-24P: model family
2	7103910	Oracle Storage Drive Enclosure DE2-24P: base chassis
48	7111109	One 1.2 TB 10000 rpm 2.5-inch SAS-3 HDD
4	333V-20-15-C14	Power cord: Sun Rack jumper, straight, 2 meters, C14 plug, C13 connector, 15 A
1	B61971	Oracle Standard System Installation Service, Without Site Audit: Storage Disk - Group III
6	B61473	Oracle Standard System Installation Service, Basic: Storage Disk - Group I
1	B72641	Oracle Standard Software Installation & Configuration for Systems Service: Base
1	B72649	Oracle Standard Software Installation & Configuration for Systems Service: Oracle ZFS Storage Appliance: Onsite Delivery
1	B58179	Oracle Premier Support for Systems - Renewal Partner

**Thin Client Device:** (500) Dell Wyse 5030 PCoIP Zero Client

Quantity	Part Number	Description
1000	5030TAA	Wyse 5030 zero client for VMware, CTOG
1000	503PCTA	5030 PCoIP - 32MB FLASH / 512MB DDR3 RAM
1000	PCOIP	Operating System – Wyse Zero Clients, English
1000	USKBYD	Dell Multimedia Keyboard-KB216 Black (US English)
1000	USBSIB	Dell MS116 USB Optical Mouse
1000	PS30W	30W AC Power Supply Adapter
1000	USPWC	System 3 ft Power Cord (English)
1000	STANDH	Horizontal Stand
1000	E1715S	Dell 17 Monitor - E1715S

1000	DVIVGA	DVI-I port. DVI to VGA (DB-15) adapter
1000	PRMI3	3 Year ProSupport with Rapid Mail In Service

**Virtualization Software:** (1000) VMware Horizon Enterprise Edition v.7 - License

Quantity	Part Number	Description
5	HZ7-ENN-100-F-L1	VMware Horizon Enterprise Edition ( v. 7 ) – license Level 1 ( 50-599 )
5	HZ7-ENN-100-F-L2	VMware Horizon Enterprise Edition ( v. 7 ) – license Level 2 ( 600-999 )
10	HZ7-ENN-100-P-SSS-F	VMware Support and Subscription Production

## Deployment Methodology

Beyond the hardware and software involved, employee training is critical. Systems Administrators must be competent and confident in the operation and troubleshooting of the entire environment. Administrators must also be well trained so that they do not try to administer the environment in efficiently, taking advantage of the centralized management aspects of the solution. Similarly, great care must be taken to ensure that the users of the new Thin Clients are comfortable in the use of the devices, happy with the capabilities, and understand the reasons for any loss of capabilities inherent in a Thin Client solution.

We follow our same methodology for all sizing configuration, scale differences with regards to the size of the user base are taken into consideration for the larger deployments.

Dynamic Systems will assign a Project Manager, as a primary point of contact (POC) with a minimum of SECRET level clearance (as needed), responsible for the following activities:

- Development and implementation of a work order system to schedule and monitor hardware and software installations
- Coordination of hardware ordering and delivery
- Management of asset tagging
- Management of resource staffing and coordination
- Coordination of hardware installation services
- Facilitation of the initiation of support services
- Overall contract management
- Coordination of support issues and escalations
- Attend project planning and status meetings
- Project status, planning and management reporting

Our Professional Services engagements include project management, hardware and software installation and implementation. The knowledge and skill of our engineers is evidenced through our multiple customer references. During implementations we encourage the customer to participate in “over the shoulder training” as an added benefit that helps ensure the mutual success of the project.

For Thin Client engagements, the engagement team consists of one or more members of each of the following teams –

- **Thin Client Virtualization Architect** – responsible for designing the overall solution architecture and working with the Project Manager and the various implementation specialists to ensure that project objectives are met;
- **Server Specialist** – responsible for rack mounting and configuring the virtualization infrastructure servers;
- **Virtualization Specialist** – responsible for installing and configuring the virtualization software needed to support the Thin Client solution;
- **Storage Specialist** – responsible for rack mounting and configuring the storage devices to allocate LUNs or filesystems needed by the Virtual Machines, user home directories, and user and application data;
- **Networking Specialist** – responsible for any solution-specific networking equipment as well as coordinating with the enterprise network team for any specific VLAN, routing, naming, or other networking-related items required for the solution;
- **Operating Systems Specialist** – responsible for creating and tuning the template VMs, working with the enterprise system administration team to create or adapt roaming profiles, integrating the solution with enterprise directory services, and ensuring support for single sign-on capabilities;
- **Security Specialist** – responsible for securing the overall Thin Client solution including operating system hardening, anti-virus and anti-malware installation and configuration, disabling unnecessary network ports, verifying user authentication and authorization is properly configured, creating and scheduling security audits, and performing an end-to-end security assessment prior to turn-over.
- **Thin Client Device Installation Team** – responsible for deploying the Thin Client devices at each of the user's desks and performing any end-user training as required.

A high-level set of tasks and associated timeline for the development of a Thin Client solution:

### Phase I – Design and Planning

Step 1: Technical Discovery and Documentation (1-3 weeks)
○ Schedule and Perform Analysis Interviews
○ Process Review and Analysis
○ Technical Review and Analysis

○ Analysis of Review Findings
Step 2: Technical Design (1-3 weeks)
○ Storage Design
○ Thin-client Design Session
○ Conceptual Design
○ Architecture Design
○ Implementation Design
○ Operational Processes Design
○ Proof of Concept Design and Planning Session
○ Implementation Design and Planning Session

Dynamic Systems has been running its business through Thin Client technology since 2004 starting with one of the earliest Thin Client solutions developed. We've moved through different network architectures to optimize Thin Client performance. We've tested Oracle, Wyse, Citrix, VMware, and many more to determine the best fit internally and for our customers. We've done extensive testing of multi-level security solutions for our military customers as well as multimedia capabilities as these were enhanced through the years. Dynamic Systems has the in-depth experience to implement, manage, maintain, and migrate ITES-3H end users' Thin Client solutions over the life of the contract and beyond.

Often, our first step to implement the Thin Client solution design is to build a test lab configuration in order to validate the technical architecture design and any assumptions made in the design process. Lab testing can be done at the customer site or on-site at Dynamic Systems where in our ESD-safe laboratory with an attached end user experience environment.

After lab testing, we update the design documents and begin planning the Proof of Concept (POC). The goal of the Proof of Concept is to perform a limited implementation involving a key test group to further validate the operational assumptions and readiness prior to investing in equipment and resources necessary for a full-scale implementation. Upon successful completion of the POC, efforts begin to transition the environment for full production readiness (i.e., scaling the servers, storage, and networking; security auditing). While completing the infrastructure scaling, we begin coordinating the phased rollout by conducting end-user and administrator trainings. Training sessions should occur within 1 to 2 weeks before migrating the user to the Thin Client desktop.

For system administrators, we provide a complete set of documentation of the delivered solution and perform knowledge transfer sessions to enable them to take over management of the solution. We recommend a pre-agreed length of time for dual-management of the environment to maximize the knowledge transfer. During the start of the operational phase, we monitor solution performance against success criteria and work to identify and resolve any identified issues. We also work with the client to understand capacity monitoring and planning as well as future requirements and needs tracking.

A high-level set of tasks and associated timeline for the implementation of the Thin Client solution design follows.

<b>Phase I – Testing and Validation</b>
Step 1: Lab Architecture Design (1 week)
Step 2: Lab Environment Setup (1-3 weeks)
Step 3: Lab Test Plan Creation and Execution (1-2 weeks)
Step 4: Documentation of Lab Test Results (1 week)
Step 5: Update Project Architecture, Design, Implementation, and Other Documents (2 weeks)
<b>Phase II – Proof of Concept</b>
Step 1: Identification of Key Milestones and Target Delivery Dates
Step 2: Selection of Hardware and Software Base
Step 3: Develop and Document Proof of Concept (POC) Plan
Step 4: Execution of POC Plan
Step 5: Documentation of POC Results
<b>Phase III – Implementation</b>
Step 1: Build out thin-client server infrastructure
Step 2: Build storage infrastructure
Step 3: Integrate server and storage infrastructure
Step 4: Build out or integrate thin-client networking infrastructure
Step 5: Implement user operating system environments
Step 6: Implement user authentication policies
Step 7: Deploy Thin Client desktops
Step 8: Activate application access
Step 9: Perform security audit
Step 10: Phased Go-Live Rollout
<b>Phase IV – Documentation and Maintenance Knowledge Transfer</b>
Step 1: Server Configuration Documentation
Step 2: Storage Configuration Documentation
Step 3: Network Configuration Documentation
Step 4: Deliver and Review Documentation with Client
Step 5: Conduct Knowledge Transfer Session(s) with Client
<b>Phase V – Operations</b>
<ul style="list-style-type: none"> <li>• Monitoring solution performance against success criteria</li> <li>• Identification and resolution of issues</li> <li>• Capacity monitoring and planning</li> <li>• Future requirements and needs tracking</li> <li>• Performance status report creation, delivery, and review</li> </ul>

## Conclusion

Nearly every federal IT organization today is faced with fiscal and security challenges while attempting to provide always-on, agile e-government services using an ever more

diverse set of devices. These competing requirements open the door for the introduction of thin-client computing environments. Thin Client architectures allow organizations to pull user data and applications back into the centrally administered datacenter while providing a user friendly computing environment. In doing so, the organization reduces the time needed to deploy, maintain and decommission applications and systems thereby reducing the operational costs of the environment.

Over the years, the IT industry proved the advantages of thin-client computing over traditional desktop environments in areas such as –

- **TCO**
  - **Device Acquisition:** Thin-client devices cost less than traditional fat-clients and have a considerably longer shelf life
  - **General Administration:** Centralized administration model reduces costs to maintain large-scale desktop environment
  - **License Administration:** Reduced cost and administration of licenses and applications
  - **Infrastructure:** Ability to efficiently utilize and spread extremely powerful server class hardware across a large number of users
  
- **Security**
  - **Device Security:** No data resides on a thin-client device since all data and applications remain in the datacenter
  - **Network Security:** Advancements in data encryption and delivery technologies via thin-client architectures increase the difficulty to maliciously access organizations data

During this time, Dynamic Systems architected, implemented, managed and maintained Thin Client implementations for our Public Sector customers as well as ourselves. As Thin Client technology advances, we intend to continue bringing its benefits to our customers.